

NOTES ON THE BIOLOGY OF THE CARABID GENERA BRACHYNUS, GALERITA AND CHLAENIUS.*

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One of the most interesting and unexpected habits recorded of the *Carabidæ* centers about the egg-laying of certain species of the genus *Chlaenius*. In a family of beetles so decidedly terrestrial in their habits we are indeed surprised to find that certain members deposit their eggs in delicate mud or clay cells high above the ground on the leaves of trees and shrubs.

Dr. C. V. Riley in the Proceedings of the Entomological Society of Washington, I, 23, 1884, was the first to record this interesting method of oviposition through his observations of the egg cells of *Chlaenius impunctifrons* Say. He also stated in this note he had strong proof that *Chlaenius aestivus* Say, *Scarites subterraneus* Fab. and the genera *Dicaelus* and *Galerita* share with *C. impunctifrons* its singular mode of oviposition. However, after the publication of this note Riley does not seem to have given his proof that the beetles in question do deposit their eggs in earthen cells as does *C. impunctifrons* nor, as far as the writer is aware, do we have further mention of this anomalous method of oviposition occurring in the Carabidæ until a recent paper by Claassen in 1919.† In this paper we are given a description and figure of the mud cells of *Chlaenius impunctifrons*, the same species reared by Riley in 1884.

The writer first observed these eggs during the summer of 1917, but was not successful in rearing the larvæ which issued beyond the third instar. As all attempts to learn the identity of the cell builder proved fruitless the study was again taken up the following year with such success that it was proven *Chlaenius aestivus* Say was one of the cell builders, however, a marked difference in the form and placement of the cells led to the conclusion there were three species of cell builders living in the same habitat. Through careful rearing from eggs to adults this proved to be true as *Galerita bicolor* Drury and

* A paper on the life histories and biology of the beetles herein mentioned is in preparation by the author.

† Claassen, W. P., Life History and Biological Notes on *Chlaenius impunctifrons* Say. Annals Ent. Soc. Amer., XII, 95-99, Pl. VI. 1919.

Chlaenius impunctifrons Say were reared from the egg cells in question. After this other habitats were studied and by careful rearing of all the eggs found and obtaining eggs from beetles in captivity, it was also proven that *Chlaenius cericeus* Forst., *Chlaenius tricolor* Dej. and *Brachynus cyanipennis* Say. also deposit their eggs in mud or clay cells constructed by the female beetle.

The form, size and structure of the mud cells of these beetles seems to be distinct in each species and this, together with decided variation in the immediate location or placement of the cells, renders specific identification possible for most of the species studied with the exception of *Brachynus*.

THE MUD CELLS OF BRACHYNUS.

The mud cells of *Brachynus cyanipennis* Say (Plate XXX, Figs. 1 and 2) are somewhat crescentic or triangular in outline, rough in surface and measure about 2.25 mm. in length, that is, the longest axis. The cells of these beetles are commonly placed on the undersurface of loosely set stones, on dead twigs and plant stems; they may be placed singly or in groups of three to ten in number. In captivity the cells were sometimes constructed massed one upon the other in clusters of eighteen to twenty-five.

THE MUD CELLS OF GALERITA.

The mud cells of *Galerita bicolor* (Plate XXX, Fig. 3) are roughly triangular in outline or purse shaped and finely granular in surface. They are 5 mm. in length and 3.5 to 4 mm. in width. The cells of this species are placed singly on the under surface of smooth leaves, *Benzoin* and *Impatiens* being most frequented by the beetles in the habitat studied.

THE MUD CELLS OF CHLAENIUS.

With *Chlaenius impunctifrons*, the species studied by Riley and Claassen, the mud cells (Plate XXX, Fig. 4) are almost always smoothly convex and oblong in outline, measuring about 3.5 mm. in length and 2.28 mm. in width. In the habitats studied it was noted that about ninety per cent of the cells of this species occur on living plants, the under surface of smooth leaves being most often selected by the beetles. The distance

above the surface of the ground at which the cells are placed varies from a few inches to seven feet or higher however, one to two feet is nearer the average.

Unlike the preceding species, *Chlaenius aestivus*, while often living in the same habitat as *C. impunctifrons*, rarely ever constructs her mud or clay cells on leaves. In the habitats studied, they were found almost exclusively on dead twigs, plant stems and the bark of trees and shrubs, the dead thorns of *Gleditsia* were much used in one habitat and in another locality they were occasionally found on the strands of a barbed wire fence. They are sometimes placed ten feet above ground.

The cells of *C. aestivus* (Plate XXXI, Figs. 1 and 2) are convex and oval in form, coarsely granular or rough in surface; length 3.75 to 4.5 mm., width 2.75 to 3 mm. The exit of the larva is effected by the breaking off of the lidlike flap, which covers one side of the cell.

The earthen egg cells of *Chlaenius cericeus* (Plate XXXI, Fig 4) are smooth in surface, 3.75 mm. in length, 2 mm. in width. In general shape they are somewhat triangular or purse shaped. The cells of this species have not been observed in nature, but in captivity the beetles placed their cells on stones and the lower parts of dead plant stems, all very near the surface of the moist soil.

The cells of *Chlaenius tricolor* are small, measuring about 2 mm. in length and 1.25 mm. in width. They are strongly rounded, oblong in outline, smooth in surface and along one side there is a distinct fold or flap which marks the point of closure. This species constructs her cells of fine clay-sand. The stems of slender grasses and sedges seem to be most frequented by the beetles. Cells were found in great abundance along the shore of the Susquehanna River at Harrisburg, Pa., on the common sedge *Eleocharis tenuis*.

CONSTRUCTION OF THE MUD CELL.

As far as the writer is aware, no one has yet noted how these cells are made. This has been observed by the author, but will be only mentioned in this preliminary note, it sufficing to state that the pellet of mud is collected by the beetle at and around the tip of the abdomen in such a way that the cell formed is in reality a mold of the caudal abdominal segments;

the lid of the cell being formed from a thin layer of mud which covers the dorsal portion of these segments. After the deposition of the egg the tip of the abdomen is withdrawn and is again used to bend down the dorsal flap or lid and close the cell, the lid of which is self sealing, because of the soft texture of the mud at the time of construction. Thus the mud cells of *Chlaenius* may be compared to a pouched envelope in form and mechanism. The folding flap and the sealing of the edge when the soft mud of the flap comes in contact with the opposite lip of the cell is not different in principle from that of a common envelope. The clay cells of *Chlaenius tricolor* (Plate XXXI, Fig. 3a) show this structure quite distinctly.

As concerns the number of cells made by an individual beetle, I have noted that *C. impunctifrons* may construct seven to twenty cells during one night and eighty-two cells in a season.

FEEDING HABITS OF THE LARVÆ.

The cell building habit of these Carabids presents several interesting biological questions. Among these is one relative to the feeding habits of the issuing larvæ. As concerns this, there is but a single note by Claassen, *Annals of the Ent. Soc. Amer.*, XII, 96, 1919. I quote the following:

"Various kinds of food were offered to the young larva (of *Chlaenius impunctifrons*); larvæ and pupæ of *Lymnaecia phragmitella* Stainton, larvæ of *Nonagria oblonga* Grote, *ArsilLonche albovenosa* Goeze, and *Arzama obliqua* Walk. Flies and fresh meat were also offered to the larva. At first the young larva fed somewhat on flies and on larvæ and pupæ of *L. phragmitella*, but it showed a decided preference for the little larvæ of *A. obliqua*.

During the second and third instar all other food was refused except larvæ of *A. obliqua*.

All the above mentioned Lepidoptera are inhabitants of Typha. *A. albovenosa* is an incidental surface feeder on the leaves; *L. phragmitella* lives in the heads of Typha, while *A. obliqua* and *N. oblonga* both begin their larval activities as leaf miners, later becoming solitary stem borers.

It is possible that the larvæ of *Chlaenius impunctifrons* feed altogether on the larvæ of *A. obliqua*. The former hatch

about the same time that the larvæ of the latter species leave the mines of the leaves of *Typha* to become stem borers. Thus while they are exposed they might easily fall prey to the Carabid larvæ."

From the above quotation it would seem that there is a possible relationship between the occurrence of the mud cells of *C. impunctifrons* on *Typha* and the food of the issuing larvæ as being the Lepidopterous inhabitants of *Typha*.

The writer believes that so far with all the known species of Carabidæ which deposit their eggs in earthen cells on plants, there is no correlation between the immediate location of the egg cells and the feeding habits of the issuing larvæ. He believes, therefore, that Claassen's statements are misleading and for *Chlaenius impunctifrons* points out the following reasons:

First, because *Chlaenius impunctifrons* is often found in abundance in habitats where *Typha* and its inhabitants are entirely wanting. Second, the larvæ of this species are not climbers, it being doubtful if they could climb the smooth leaves of *Typha*. As observed by the writer the larvæ either in captivity or in nature were never seen to climb and in their natural state have been observed at night running about among stones and debris on the muddy shores of the Susquehanna. In nature I have never observed the larvæ feeding, however, in captivity they were general feeders preying upon all soft bodied insects which were not too active to escape them. They fed greedily on small Lepidopterous larvæ (Gelechids and Geometrids) Collembola, termites, crippled flies and the larvæ and pupæ of several species of ants. The ant larvæ and pupæ were easily collected and proved an ideal food for the Carabid larvæ, consequently they were used as the chief food in rearing all the species mentioned in this paper, with the exception of *Brachynus*.

A further lack of such correlation between the place of egg laying and the feeding habits of the larvæ is shown in *Chlaenius aestivus* which deposits her eggs in cells on dead twigs, tree trunks and many other objects not supporting any forms of life at all. Lastly, in *Brachynus*, which genus also shares this cell building habit, we have parasitic larvæ, the hosts of which are often quite removed from the twigs, stems and stones on

which the egg cells are found. The larvæ of *Brachynus cyanipennis* mentioned in this paper, are parasitic on the pupæ of *Dineutes discolor*.

PARASITES.

A number of minute Hymenopterous parasites have been reared from the egg cells of these Carabids. With *Brachynus* as high as fifty per cent of the eggs found in nature were parasitized by tiny winged and wingless Hymenoptera of the genus *Hoplogryon*. All parasites of *C. impunctifrons*, *C. aestivus*, and *C. tricolor* were winged. In one habitat studied the eggs of *C. tricolor* were parasitized to the extent of twenty-five per cent, by a minute Hymenopteron, *Prosacantha caraborum* Riley, which is a common parasite of several species of *Chlaenius*.

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EXPLANATION OF PLATES.

PLATE XXX.

(Figures seven diameters.)

- Fig. 1. Masses of mud cells of *Brachynus cyanipennis*. Cells made by beetles in captivity.
Fig. 2. Mud cells of *Brachynus cyanipennis* as found in nature on the under surface of a stone.
Fig. 3. Mud cell of *Galerita bicolor* on the under surface of Impatiens leaf.
Fig. 4. Mud cell of *Chlaenius impunctifrons* on under surface of Benzoin leaf.

PLATE XXXI.

(Figures seven diameters.)

- Fig. 1. Mud cells of *Chlaenius aestivus* on dead twig.
Fig. 2. Mud cells of *Chlaenius aestivus* showing lidlike opening for escape of the larva.
Fig. 3. Mud cells of *Chlaenius tricolor* on sedge, *Eleocharis tenuis*.
 a. Lateral aspect showing fold.
 b. Lateral aspect showing side opposite fold.
 c. Lateral aspect, fold removed showing egg.
Fig. 4. Mud cells of *Chlaenius cericeus*.
 a. Cell which was removed from surface of a stone.
 b. Cell on sedge.